# SOFT COMPUTING LAB MANUAL

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# Topics Covered in the Assignments

**Fuzzy Logic** 

**Fuzzy Set Operations** 

Membership functions

**Fuzzy Rules** 

**Fuzzy Inference System** 

**Genetic Algorithms** 

# Assignment 1

On two fuzzy sets A and B, Implement the following Fuzzy Set Operations:

- 1. Sum (A+B)
- 2. Difference (A-B)
- 3. Cartesian product
- 4. Union (AUB)
- 5. Intersection of A and B
- 6. Complement of A

### **Assignment 2**

Implement the following membership functions:

- Triangular
- Trapezoidal
- Gaussian
- Generalized Bell
- Sigmoidal

### **Assignment 3**

Find applications where you find fuzzy logic to be suitable

# **Assignment 4**

Find specific scenarios where Gaussian Membership function can be applied

### **Assignment 5**

Implement min-max and max-product composition

### **Assignment 6**

Consider a universe representing room temperature in degree C and other universe representing relative humidity given by

$$T = 0.4/16 + 0.8/18 + 1.0/20 + 1.0/22 + 0.8/24 + 0.5/26$$

$$H = 0.2/0 + 0.8/20 + 1.0/40 + 0.6/60 + 0.2/80$$

Calculate the membership of "Acceptable Temperature OR Acceptable Humidity".

# **Assignment 7**

Given, following membership functions for fuzzy sets old and young

$$\mu_{young}(x) = bell(x, 20, 2, 0)$$

$$\mu_{old}(x) = bell(x, 30, 3, 100)$$

Where, x is the age of the person. Calculate the value of the following:

- 1. More or less young
- 2. Not young and not old
- 3. Young but not too young
- 4. Extremely old

### Assignment 8

Given, following relations:

R1 = "x is relevant to y"

R2 = "y is relevant to z"

Where

 $X = \{1, 2, 3\}$ 

 $Y = \{a,b,c,d\}$ 

 $Z = \{one, two\}$ 

Assuming appropriate values for R1 and R2, calculate the max-min composition and max product composition for (3, one).

### **Assignment 9**

Take different elements of a fuzzy set as user input and defuzzify using Bisector of area, Centroid of area, Mean of Maximum and Smallest of maximum.

### Assignment 10

Given, following rules:

Rule 1: If BP is high and temperature is high then health is Poor

Rule2: If BP is normal and temperature is normal then health is Good

Rule 3: If BP is low and temperature is normal then health is Normal.

Take the values of Blood Pressure and Temperature as User input and determine the health of the person.

### Assignment 11

Solve the Air conditioner controller problem using Fuzzy Inference System. Frame the rules. Compare the results using Mamdani, Sugeno and Tsukamoto FIS.

### An example of Fuzzy Rule Base could be something like this

Rules	Temperature	Humidity	Compressor speed
1.	Very Low	Dry	Off
2.	Very Low	Comfortable	Off
3.	Very Low	Humid	Off
4.	Very Low	Sticky	Low
5.	Low	Dry	Off
6.	Low	Comfortable	Off
7.	Low	Humid	Low
8.	Low	Sticky	Medium
9.	High	Dry	Low
10.	High	Comfortable	Medium
11.	High	Humid	Fast
12.	High	Sticky	Fast
13.	Very High	Dry	Medium
14.	Very High	Comfortable	Fast
15.	Very High	Humid	Fast
16.	Very High	Sticky	Fast

### Assignment 12

Design a Fuzzy logic based washing control on a Washing machine

The amount of water, dirt in the cloth and other parameters will decide the time taken in washing

Initialize input parameters like washing time, amount of dirt etc. -> Initialize fuzzy system with membership function-> Define fuzzy rules->Get fuzzy decision for washing time prediction

# Genetic Algorithms

### **Assignment 13**

For any sample data set, implement Order Encoding for Travelling Salesman Problem

### Assignment 14

For any sample data set, implement Binary Encoding for 0/1 Knapsack problem

### **Assignment 15**

Use proper encoding technique to represent a chromosome in 8queens problem.

# Assignment 16

Given, a population of size N, create a mating pool of  $N_p$  individuals using different selection techniques that you have studied in your lectures.

# Assignment 17

Use GA to solve the following nonlinear programming problem Minimize  $(x_1-2.5)^2+(x_2-5)^2$  Subject to

$$5.5x_1 + 2x_2^2 - 18 \le 0$$
$$0 \le x_1, x_2 \le 5$$

X1 and x2 have three and two decimal places respectively

- 1. Encode using binary encoding
- 2. Compute the fitness and perform crossover and mutation to yield optimum results.